

AD\_\_\_\_\_

Award Number: DAMD17-99-2-9036

TITLE: Shoreline Stabilization Design and Wetland Restoration

PRINCIPAL INVESTIGATOR: Carlton L. Hill

CONTRACTING ORGANIZATION: Virginia Commonwealth University  
Richmond, Virginia 23284

REPORT DATE: May 2001

TYPE OF REPORT: Final

PREPARED FOR: U.S. Army Medical Research and Materiel Command  
Fort Detrick, Maryland 21702-5012

DISTRIBUTION STATEMENT: Approved for Public Release;  
Distribution Unlimited

The views, opinions and/or findings contained in this report are  
those of the author(s) and should not be construed as an official  
Department of the Army position, policy or decision unless so  
designated by other documentation.

20020502 092

# REPORT DOCUMENTATION PAGE

Form Approved  
OMB No. 074-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing this collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188), Washington, DC 20503

1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE	3. REPORT TYPE AND DATES COVERED	
	May 2001	Final (15 Sep 99 - 31 May 01)	
4. TITLE AND SUBTITLE SHORELINE STABILIZATION DESIGN AND WETLAND RESTORATION		5. FUNDING NUMBERS DAMD17-99-2-9036	
6. AUTHOR(S) Carlton L. Hill			
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Virginia Commonwealth University Richmond, Virginia 23284  E-Mail:		8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES) U.S. Army Medical Research and Materiel Command Fort Detrick, Maryland 21702-5012		10. SPONSORING / MONITORING AGENCY REPORT NUMBER	
11. SUPPLEMENTARY NOTES			
12a. DISTRIBUTION / AVAILABILITY STATEMENT Approved for Public Release; Distribution Unlimited.		12b. DISTRIBUTION CODE	
13. ABSTRACT (Maximum 200 Words)			
14. SUBJECT TERMS		15. NUMBER OF PAGES 25	16. PRICE CODE
17. SECURITY CLASSIFICATION OF REPORT Unclassified	18. SECURITY CLASSIFICATION OF THIS PAGE Unclassified	19. SECURITY CLASSIFICATION OF ABSTRACT Unclassified	20. LIMITATION OF ABSTRACT Unlimited

## Table of Contents

Cover.....	1
SF 298.....	II
<b>Shoreline Stabilization Design and Wetland Restoration Project.....</b>	<b>2</b>
Memorial Park, Phase II.....	2
LTA Pool and Parking Lot.....	3
Building 578 Spit Area.....	4
Building 617 Boat Ramp and Parking Lot.....	4
Mobile Radar Site.....	5
Discussion and Final Comments.....	5
Attachment A – Shoreline Stabilization Design Memorial Park – Phase II.....	7
Attachment B – Shoreline Stabilization Design Pool and Pump House Area.....	8-10
Attachment C – Shoreline Stabilization Design Marina Spit Area.....	11-13
Attachment D – Shoreline Stabilization Design Marina Parking Lot .....	14-20
Attachment E – Shoreline Stabilization Design Mobile Radar Site.....	21-23

## Shoreline Stabilization Design and Wetland Restoration Project

The Shoreline Stabilization and Wetland Restoration Project was a cooperative effort between the United States Air Force, Langley Air Force Base (LAFB) and the Commonwealth of Virginia, Department of Conservation and Recreation (DCR). The project was for the design of shoreline stabilization and potential wetland restoration at five sites within LAFB. DCR would further expand the cooperative effort by contracting with Old Dominion University Research Foundation (ODURF) and The Coastal Engineering Centre at Old Dominion University for design solutions at the sites.

The project addressed LAFB desire to develop cooperative projects with DCR to become an active participant in improving water quality in the Chesapeake Bay. The project addresses the "Action Items for the Chesapeake Bay Program" of September 14, 1993 developed by the Department of Defense and the Environmental Protection Agency on April 20, 1990. The specific Goals of the Action Plan addressed are "Restore and Protect Living Resources" and "Improve Water Quality". The proposed shoreline stabilization planning is proposed in conjunction with the 1998 Federal Agencies Chesapeake Bay Ecosystem Unified Plan initiatives as well as the Chesapeake 2000 Agreement.

The publication entitled Shoreline Situation Report: City of Hampton reports that the historical erosion rate along the LAFB shoreline may vary from being stable to less than 1 foot per year. The report was printed in 1975 and provides historical insight into the erosion problem along the base. However, base mission needs have developed sections of the shoreline that are now threatened by long-term erosion. Therefore, shoreline stabilization and possible wetland restoration plans were developed for the following sites:

- Memorial Park, Phase II
- LTA Pool and Parking Lot
- Building 578 Spit Area
- Building 617 Boat Ramp and Parking Lot
- Mobile Radar Site

### Memorial Park, Phase II

Historically, LAFB attempted to prevent erosion along the Memorial Park shoreline by placing concrete rubble, broken bricks and block, and asphalt chunks against the bank. The rubble was placed per no specific design and filter cloth was not used under or behind the material. While the rubble slowed the erosion, normal tidal action and elevated water levels associated with storms could penetrate the rubble and erode the bank.

LAFB in cooperation with the Norfolk District, U. S. Army Corps of Engineers designed and constructed a riprap structure to protect the Memorial Park shoreline in 1998. Due to limited project funding, approximately 700 feet of shoreline could not be protected.

Phase II of the Memorial Park project extends the riprap structure along the remaining shoreline. The existing broken concrete and other rubble is to be removed, the bank reshaped and the riprap structure installed. Broken concrete and rubble suitable for use as core material in the structure will be salvaged and used. Material not used as core for this site will be stockpiled for later use in other structures. Material not suitable for use in the structures will be hauled away and properly placed in a disposal site. In this phase, there is no room for wetland restoration due to the existing topography of the bank and the proximity of the oyster lease lines.

The plans for the site are provided as Attachment A.

#### LTA Pool and Parking Lot

The shoreline in this area is eroding and subject to impact from elevated water levels and waves associated with Northeasters. Historically, LAFB has placed concrete rubble to protect the pool and pump house (building 903). The rubble was placed per no specific design and filter cloth was not used under or behind the material. While the rubble slowed the erosion, normal tidal action and elevated water levels and waves associated with Northeasters have continued to erode the shoreline. In addition, there is extensive research and restoration of historical submerged aquatic vegetation just off shore of the proposed stabilization project.

To protect the pool, pump house and parking lot, a properly designed and constructed riprap structure and marsh grass planting is proposed for the area. The existing concrete rubble will be removed, the bank reshaped, and the riprap structure installed. If necessary, fill may be placed to rebuild and reshape the bank. Broken concrete and rubble suitable for use as core material in the structure will be salvaged and used. Material not used as core for this site may be stockpiled for later use in other structures. Material not suitable for use in the structures will be hauled away and properly placed in a disposal site.

Smooth cordgrass (*spartina alterniflora*) is proposed for planting between the mean high and mean low water elevations. The proposed planting will supplement the existing grasses. The grasses will be planted on an 18 inch by 18 inch grid. The grasses will be fertilized at planting. Grasses established on this site would provide marsh restoration for the marsh displaced due to the construction of the revetment and enhance water quality in the area.

The plans for the site are provided as Attachment B.

### Building 578 Spit Area

The shoreline on the south side of the marina is eroding due to normal tidal action and elevated water levels and waves associated with storms. The erosion has damaged sections of the existing parking lot and curb. Erosion on the northern end of the spit has begun to flank the existing bulkhead protecting the marina. If the erosion is allowed to continue, the marina bulkhead and parking lot will suffer further damage. Historically, LAFB has placed a minimal amount of broken concrete in the area in an attempt to control the erosion.

To prevent further erosion of the spit and to protect the marina bulkhead from flanking, a properly designed and constructed riprap structure is proposed for the area. The existing concrete rubble will be removed, the bank graded reshaped, and the riprap structure installed. If necessary, fill may be placed to rebuild and reshape the bank. Broken concrete and rubble suitable for use as core material in the structure will be salvaged from the site and other shoreline projects on the base.

Smooth cordgrass (*spartina alterniflora*) is proposed for planting between the mean high and mean low water elevations. The proposed planting will supplement the existing grasses. The grasses will be planted on an 18 inch by 18 inch grid. The grasses will be fertilized at planting. Grasses established on this site would provide habitat and enhance water quality in the area.

The plans for the site are provided as Attachment C.

### Building 617 Boat Ramp and Parking Lot

Placing soil over broken concrete, asphalt chunks, and broken bricks and blocks probably created the land in this area. The material was most likely placed to prevent erosion and to create land for the parking lot and boat ramp. The mass of material at the site reduces the erosion, but soil is being lost due to normal tidal action and high water levels associated with storms. Proper shoreline stabilization will provide for a much needed vegetated buffer between the river and the parking lot boundary.

A properly designed and constructed riprap structure with supplemental marsh grass plantings is proposed for this shoreline. The existing fill material will be removed, the bank reshaped, and the riprap structure installed. If necessary, fill may be placed to rebuild and reshape the bank. Broken concrete and rubble suitable for use as core material in the structure will be salvaged and used. Material not used as core for this site may be stockpiled for later use in other structures. Material not suitable for use in the structures will be hauled away and properly placed in a disposal site.

Smooth cordgrass (*spartina alterniflora*) is proposed for planting between the mean high and mean low water elevations. The proposed planting will supplement the existing grasses. The grasses will be planted on an 18 inch by 18 inch grid. The grasses will be

fertilized at planting. Grasses established on this site would provide habitat and enhance water quality in the area.

The plans for the site are provided as Attachment D.

#### Mobile Radar Site

The site is located within a tidal marsh and consists of an elevated pad above the marsh. The marsh surrounding the site provides protection during normal tidal cycles. The high water levels, storm surge, associated with coastal storms flood the protective marsh and allows storm waves and stormwater runoff to erode the fill. Sandbags have been placed by LAFB to protect the fill. However, long-term protection for the site is needed to insure success of the required mission. In the event mission requirements are no longer necessary to occupy this particular area within the marsh, the site would be well suited to removing the access road and pad and restoring the native marsh system.

The proposed protection for the site consists of an elevated pad with a properly designed and constructed riprap structure to prevent erosion of the fill. Broken concrete recycled from the other shoreline projects should be used as core in the structure. Class II riprap would be used as the armor stone in the structure. The fill used to raise the elevation of the pad should be a clean sandy soil. The marsh grass plantings from the other shoreline projects may be proposed as mitigation for the wetland impacts of this project.

The plans for the site are provided as Attachment E.

#### Discussion and Final Comments

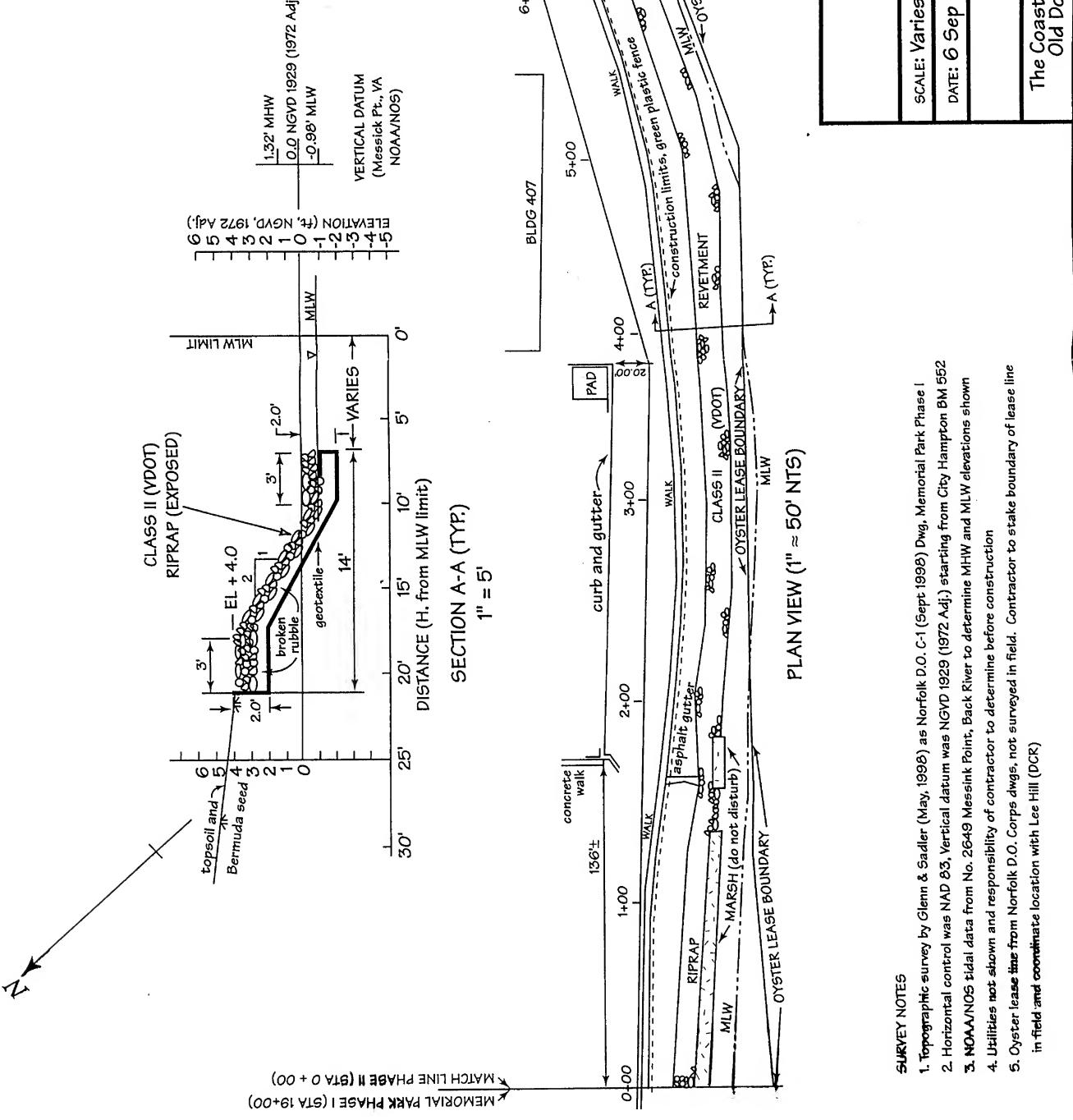
The implementation of environmentally sound and cost effective shoreline protection and wetlands restoration projects by LAFB is to be commended. The cooperative effort with DCR and ODURF was an attempt to expand interagency coordination on shoreline projects and expand technical expertise available to LAFB. The project was also an attempt between DCR and LAFB to minimize design costs for projects. Based on the experience with this project, the following recommendations for future shoreline restoration or protection projects at LAFB are provided:

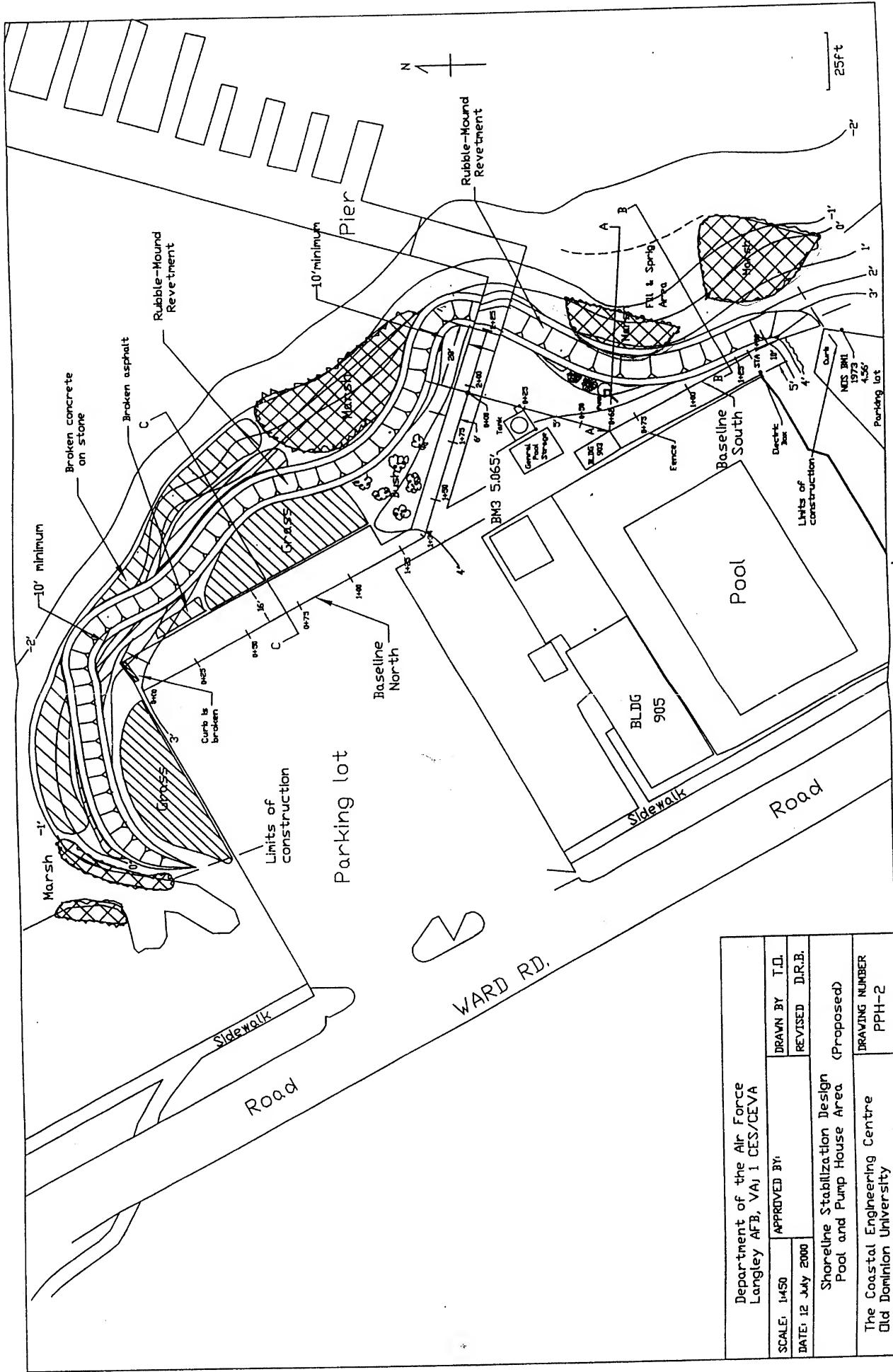
1. LAFB and DCR should develop a Memorandum of Understanding (MOU) regarding technical advice to be provided on proposed shoreline protection or restoration projects. The MOA would identify the role of LAFB and DCR in the development, permitting, bidding, funding and construction of identified projects.
2. DCR's Shoreline Erosion Advisory Service (SEAS) provides free technical advice to private property owners regarding shoreline erosion control. As SEAS advice would be provided at no charge to LAFB, as identified in the MOA, all costs associated with design could and should be used to enhance construction monies available for proposed projects.

3. An overall shoreline management plan should be developed for LAFB. LAFB and DCR staffs have worked together in the past to develop shoreline protection or restoration projects and have developed an “unofficial” management plan for the base.
4. LAFB and DCR staff should continue to cooperate in the development of shoreline protection or restoration projects for the base.

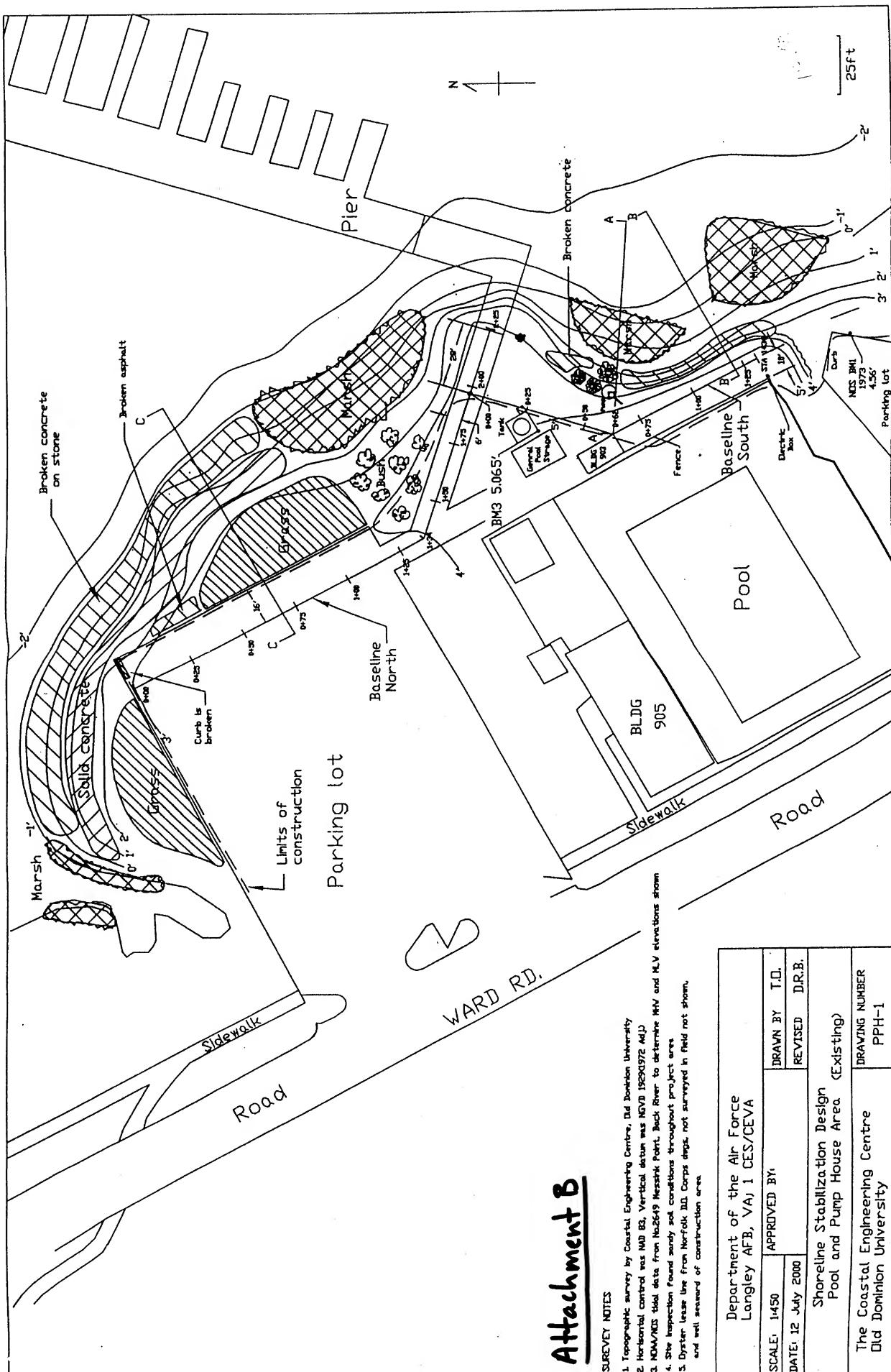
**CONSTRUCTION NOTES**

1. Remove existing broken concrete rubble
2. Regrade existing slope 2H:1V
3. Install geotextile material on slope
4. Use "best" pieces of broken rubble to cover bottom layer; see 10 below
5. Haul away and dispose offsite excess broken materials
6. Install 1.5 ft. thick layer of VDOT, Class II riprap covering bottom layer completely. Top layer (exposed) must be VDOT, Class II riprap
7. Avoid equipment damage to existing sidewalk, piers, bulkheads, trees, shrubs, etc. Contractor liable
8. Regrade slope at rear of revetment and reseed
9. All work to begin 10-15 ft. (varies) landward of MLW shoreline. Do not disturb seaward of MLW
10. Use additional, acceptable concrete stockpiles at LIA radar site





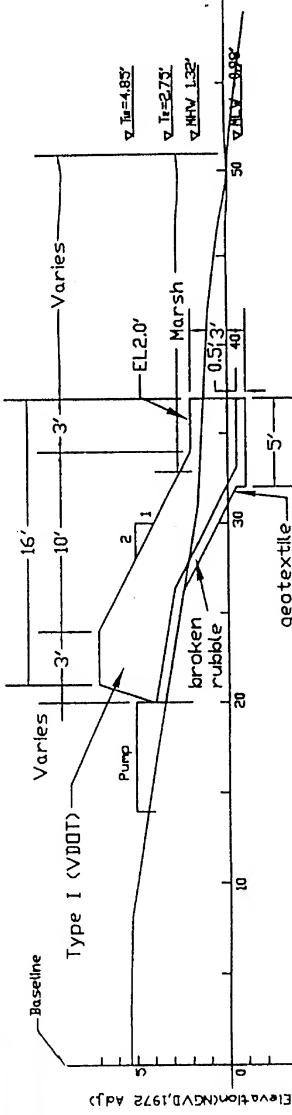
Department of the Air Force Langley AFB, VA 1 CES/CEVA	APPROVED BY T.D.	DRAWN BY T.D.
SCALE 1:450	REVISED	D.R.B.
DATE 12 JULY 2000	Shoreline Stabilization Design Pool and Pump House Area (Proposed)	
The Coastal Engineering Centre Old Dominion University		DRAWING NUMBER PPH-2



### Construction Notes

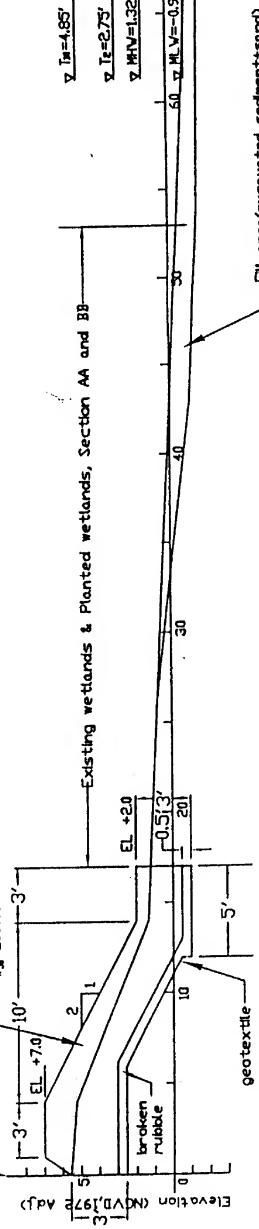
1. Remove existing broken concrete rubble to allow for fabric installation and revetment construction
2. Grade existing slope 2H:1V
3. Install geotextile material on slope and under toe
4. Use pieces of broken rubble to cover bottom layer. See 9 below
5. Haul away and dispose offsite excess broken material
6. Install 2.5ft. thick layer of VDOT, Type I Riprap covering layer completely. Top layer must be VDOT, Type I Riprap
7. Avoid equipment damage to existing sidewalk, pliers, bulkheads, trees, shrubs, etc. Contractor liable
8. Grade slope at rear of revetment and reseed
9. Use additional, concrete stockpiled at the LIA radar site

### Section A-A

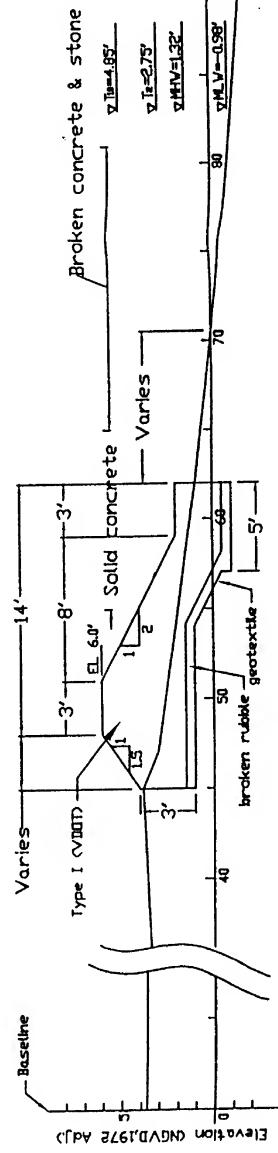


### Planting Details - Phase II

1. Within tidal zone, between NHW(+132') and low water at -13'
2. Stagger rows on 1.5' centers
3. Plant at random, Spartina, Alterniflora
4. Use nursery grown or collected sprigs
5. Plant sprig to approximate depth characteristic of collection site
6. Fertilize per specification



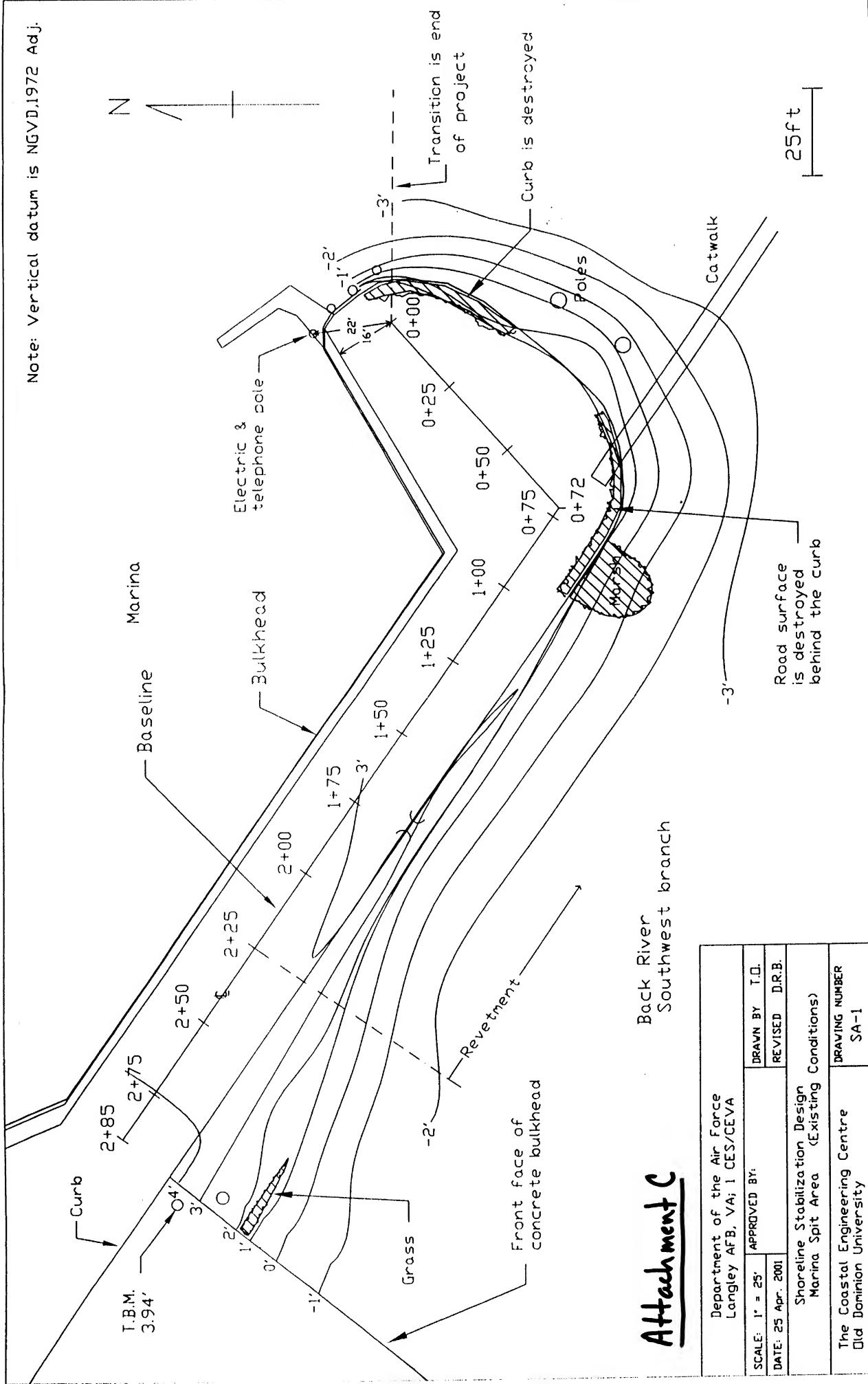
### Section B-B



### Section C-C

Department of the Air Force Langley AFB, VA 1 CES/CEVA	APPROVED BY:	DRAWN BY: T.O.
SCALE: Varies	DATE: 12 July 2000	REVISED: DR.B.
		Shoreline Stabilization Design Pool and Pump House Area
The Coastal Engineering Centre Old Dominion University		DRAWING NUMBER PPH-3

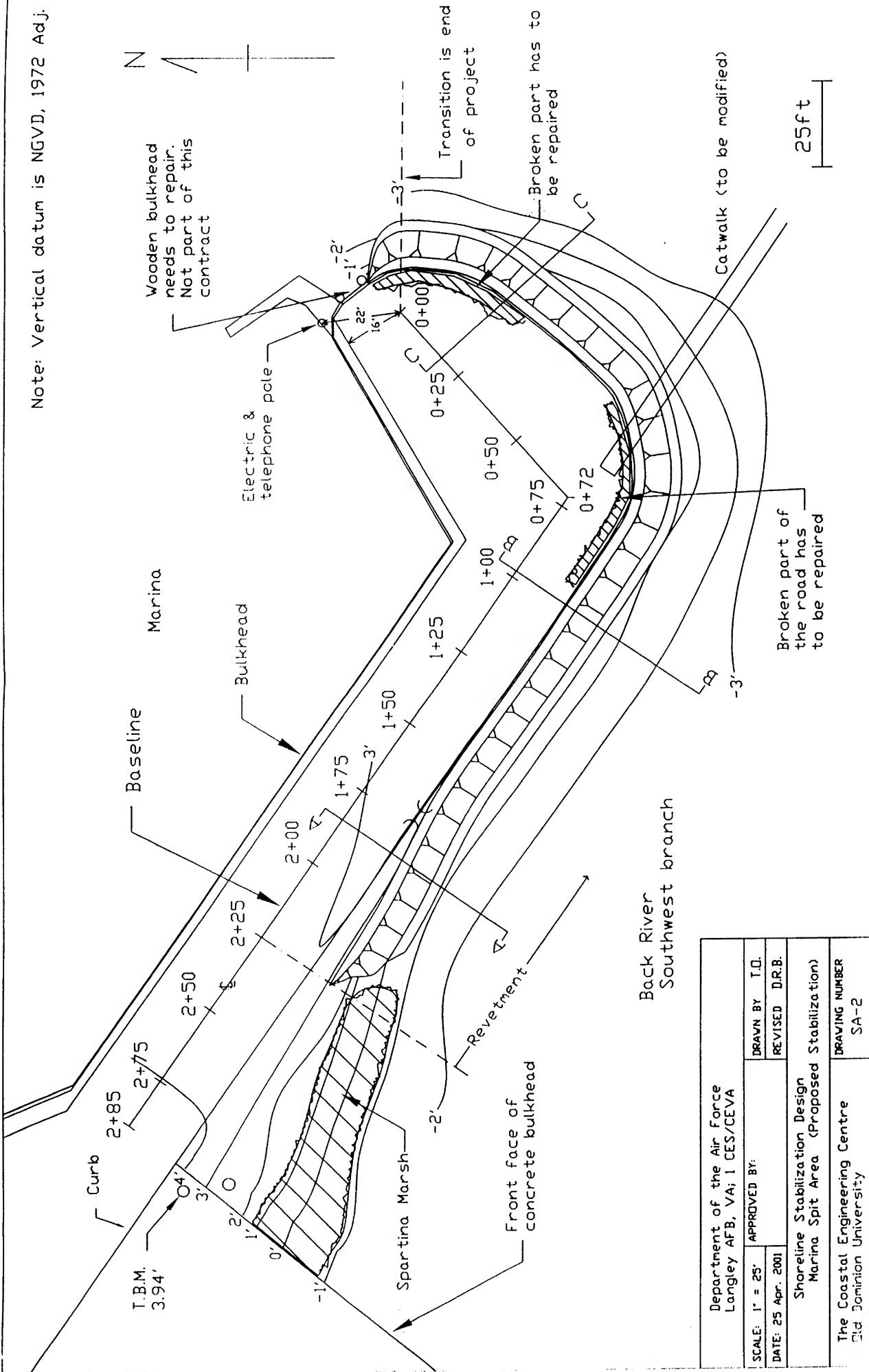
Note: Vertical datum is NGVD, 1972 Adj.

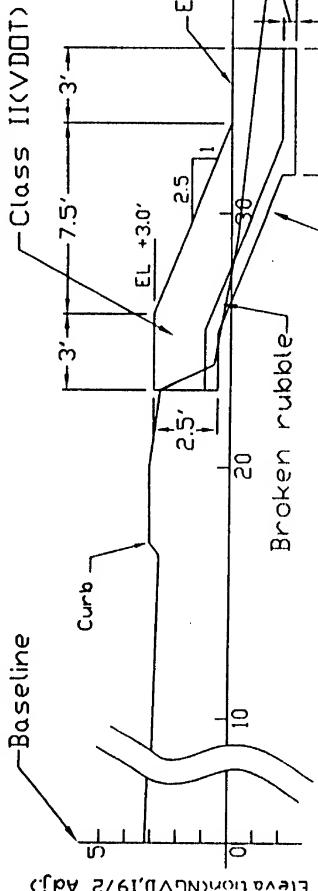


## Attachment C

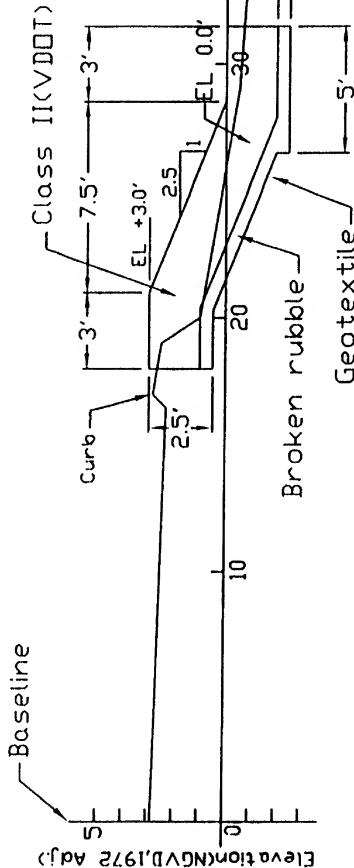
Department of the Air Force Langley AFB, VA; 1 CES/CEVA			
SCALE: 1" = 25'	APPROVED BY:	DRAWN BY	T.O.
DATE: 25 Apr. 2001		REVISED	D.R.B.
Shoreline Stabilization Design Marina Spit Area (Existing Conditions)		DRAWING NUMBER SA-1	
The Coastal Engineering Centre		Old Dominion University	

Note: Vertical datum is NGVD, 1972 Adj.

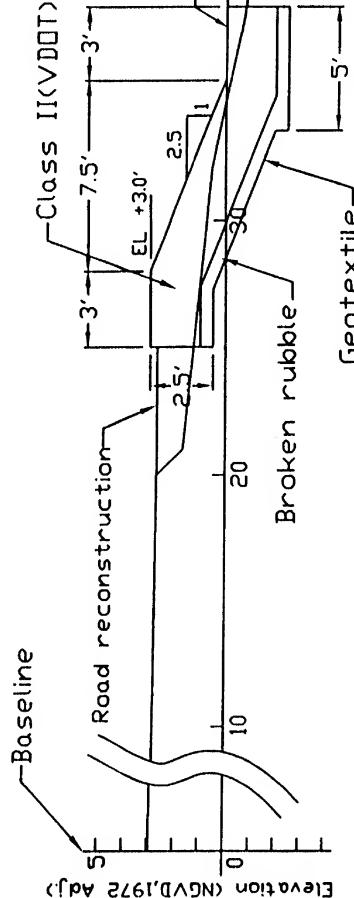




## Section A-A



## Section B-B



## Section C-C

**Construction Notes**

1. Remove existing broken concrete rubble to allow for fabric installation and revetment construction
2. Regrade existing slope 2H: 1V
3. Install geotextile material on slope and under toe
4. Use pieces of broken rubble to cover bottom layer  
See 9 below
5. Any unsightly landscape shall be hauled away and disposed of at an appropriate off base facility
6. Install 2.5ft. thick layer of VDOT, Class II Riprap covering layer completely. Top layer must be VDOT, Class II Riprap
7. Avoid equipment damage to existing sidewalk, piers, bulkheads, trees, shrubs, etc. Contractor liable
8. Regrade slope at rear of revetment and reseed
9. Use additional concrete from Langley recycled clean concrete stockpile

**Construction Notes**

1. Remove existing broken concrete rubble to allow for fabric installation and revetment construction
2. Regrade existing slope 2H: 1V
3. Install geotextile material on slope and under toe
4. Use pieces of broken rubble to cover bottom layer  
See 9 below
5. Any unsuitable landscape shall be hauled away and disposed of at appropriate off base facility
6. Install 2.5ft. thick layer of VDOT, Class II Riprap covering layer completely. Top layer must be VDOT, Class II Riprap
7. Avoid equipment damage to existing sidewalk, piers, bulkheads, trees, shrubs, etc. Contractor liable
8. Regrade slope at rear of revetment and reseed
9. Use additional, concrete from Langley recycled clean concrete

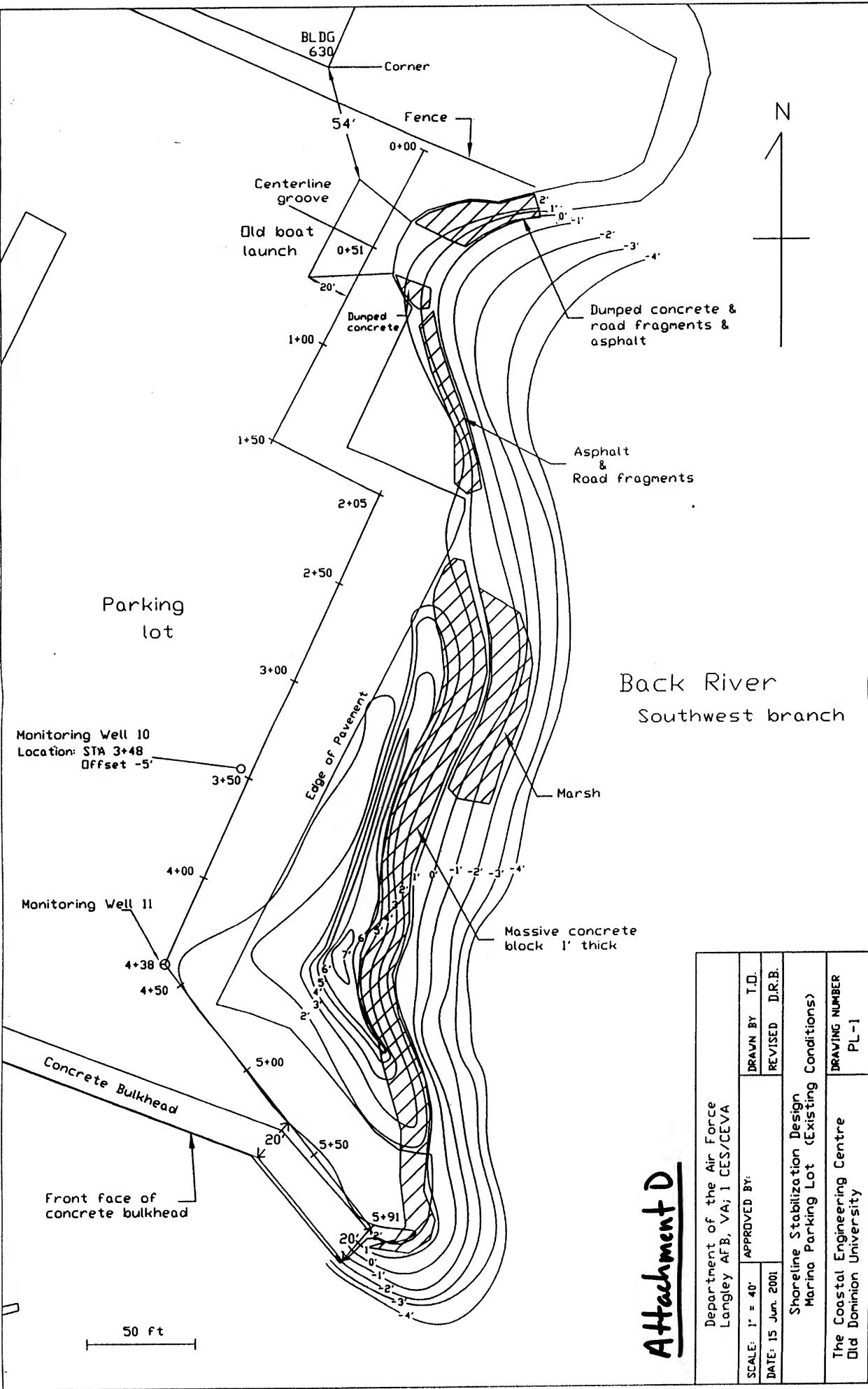
**Planting Details**

1. Within tidal zone, between MHW(+1.32') and low water at -1.3'
2. Stagger rows on 15' centers
3. Plant to be spaced 15' in a row, *Spartina Alterniflora*
4. Use nursery grown or collected sprigs
5. Plant sprig to approximate depth characteristic of collection site
6. Fertilize per specification

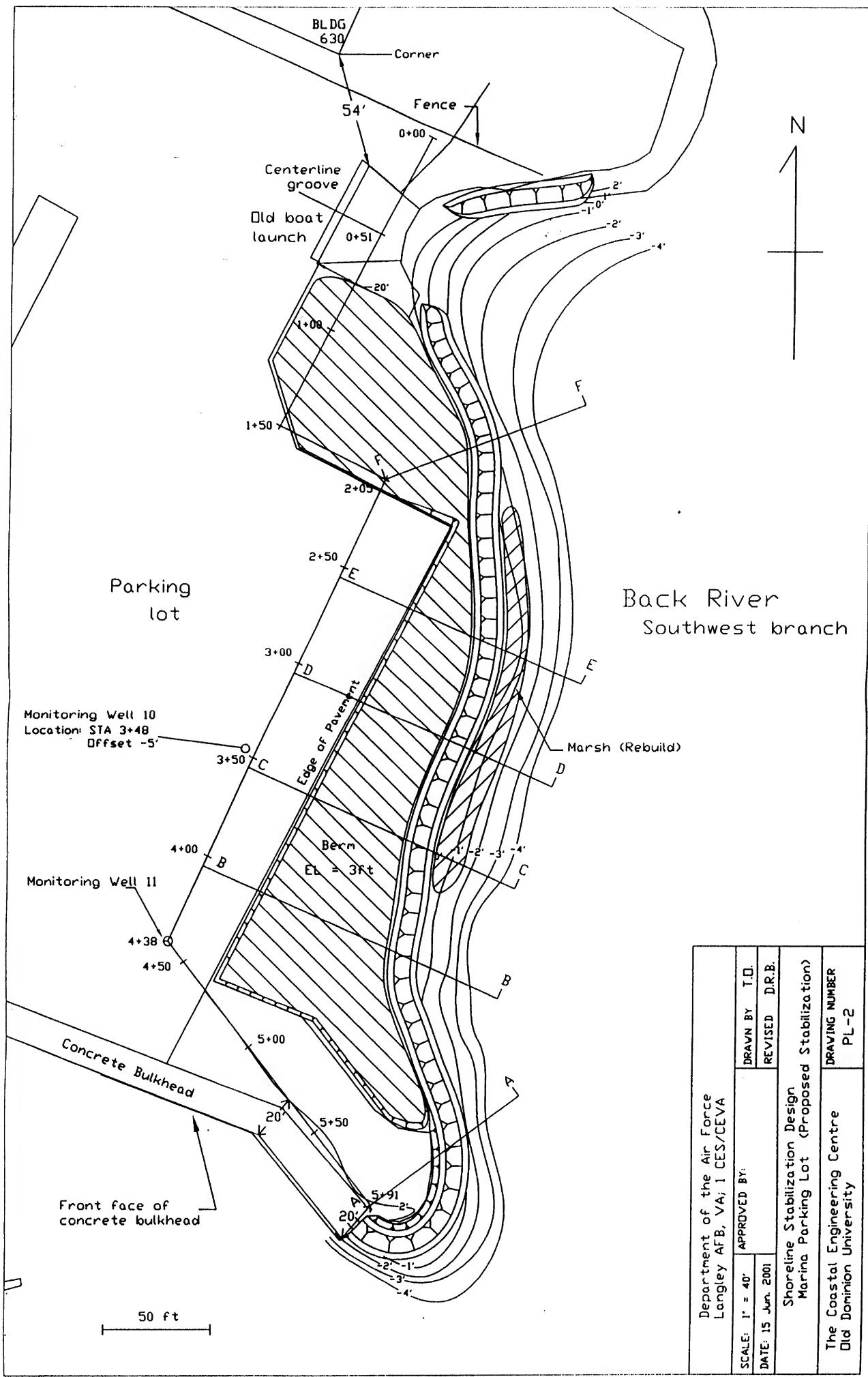
Planting Notes

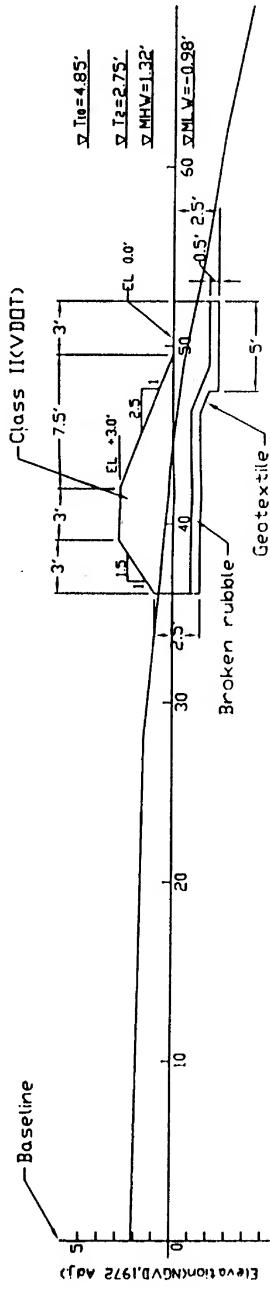
1. Contractor responsible for planting or furnishing marsh grass plants
2. Contractor responsible for preparing all beds to slopes shown using select materials
3. All upland areas disturbed by construction shall be topsoiled and seeded per specifications

Department of the Air Force Langley AFB, VA; 1 CES/CEVA		DRAWN BY T.O.
SCALE: 1' = 5'	APPROVED BY:	REVISED D.R.B.
DATE: 25 Apr. 2001		
Shoreline Stabilization Design Marina Spit Area (Details)		
The Coastal Engineering Centre Old Dominion University		DRAWING NUMBER SA-3

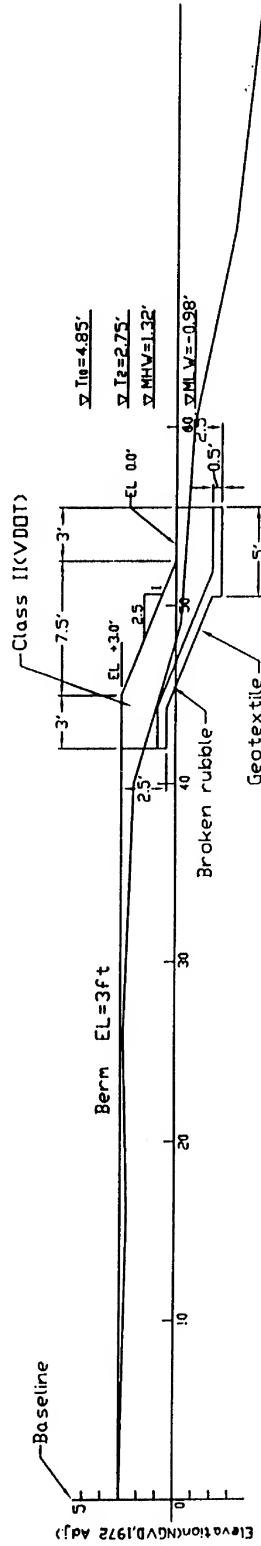


Department of the Air Force Langley AFB, VA; 1 CES/CEVA	APPROVED BY:	DRAWN BY T.O.
SCALE: 1' = 40'	DATE: 15 Jun. 2001	REVISED D.R.B.
Shoreline Stabilization Design Marina Parking Lot (Existing Conditions)		DRAWING NUMBER PL-1
The Coastal Engineering Centre Old Dominion University		





Section A-A

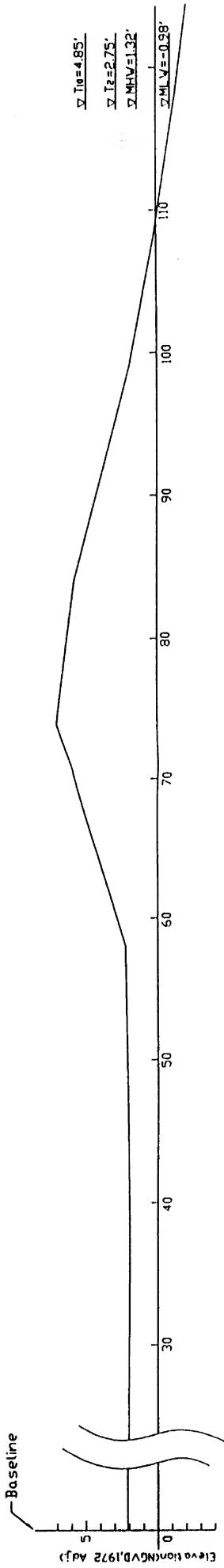


Section F-F

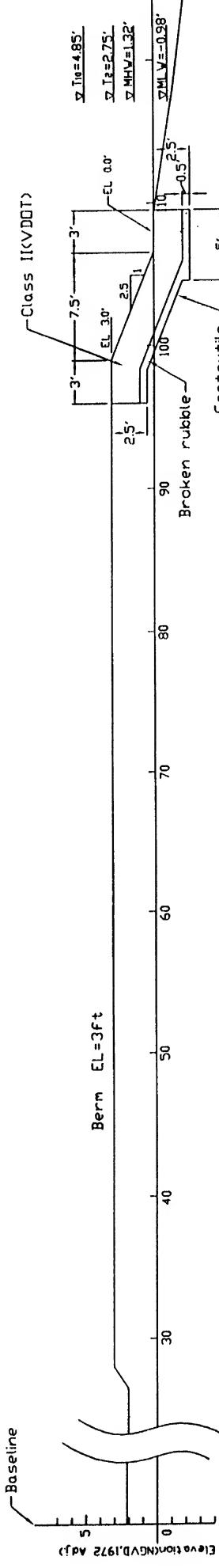
Construction Notes

1. Remove existing broken concrete rubble to allow for fabric installation and revetment construction
2. Regrade existing slope 2.5H:1V
3. Install geotextile material on slope and under toe
4. Use pieces of broken rubble to cover bottom layer  
See 9 below
5. Any unsuitable hardscape shall be hauled away and disposed of at appropriate off base facility
6. Install 2.5ft. thick layer of VDDT, Class II Riprap covering layer completely. Top layer must be VDDT, Class II Riprap
7. Avoid equipment damage to existing sidewalk, piers, bulkheads, trees, shrubs, etc. Contractor liable
8. Regrade slope at rear of revetment and reseed
9. Use additional concrete from Langley recycled clean concrete stockpile

Department of the Air Force Langley AFB, VA; CES/CEVA	APPROVED BY:	DRAWN BY T.O. REVISED D.R.B.
SCALE: 1' = 7'	DATE: 15 Jun. 2001	
Shoreline Stabilization Design Marina Parking Lot (Details, No.1)	The Coastal Engineering Centre Old Dominion University	DRAWING NUMBER PL-3



Existing Condition

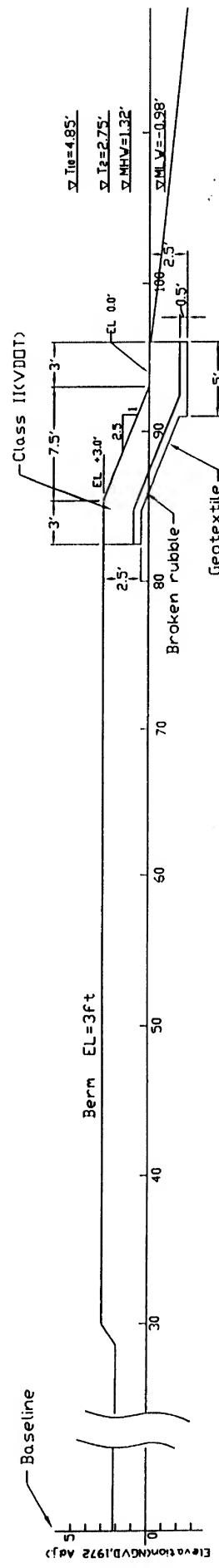
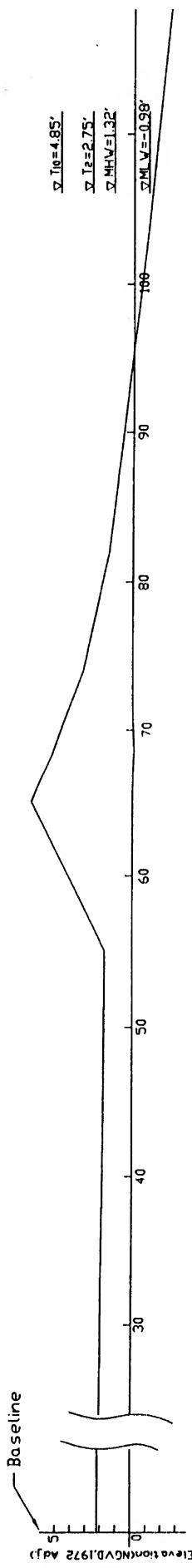


Section B-B

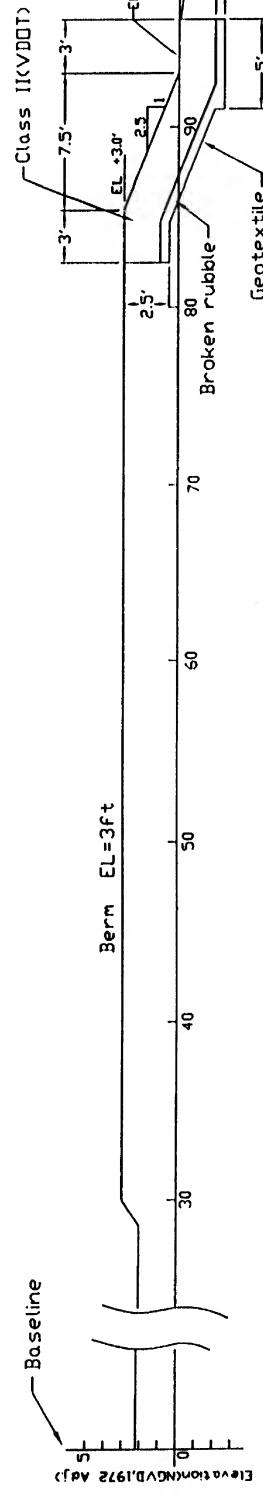
Construction Notes II (Berm)

1. Remove existing soil and concrete pieces from the mound for berm construction
2. Reroute existing slope flat berm
3. Crash concrete pieces to make them fill material
4. Use pieces of broken rubble to cover bottom of the berm See 9 below
5. Any unsuitable hardscape shall be hauled away and disposed of at appropriate off base facility
6. Install soil layer on top of broken rubble layer, berm top elevation has to be 3ft (NGVD 1972 Adj.)
7. Avoid equipment damage to existing sidewalk, piers, bulkheads, trees, shrubs, etc. Contractor liable
8. Reseed on top of the berm (see Planting Detail II)
9. Use additional, concrete from Langley recycled clean concrete stockpile

Department of the Air Force Langley AFB, VA; CES/CEVA	APPROVED BY:	DRAWN BY T.O.
SCALE: 1" = 7'	DATE: 15 Jun. 2001	REVISED D.R.B.
Shoreline Stabilization Design Marina Parking Lot (Details, No.2)		
The Coastal Engineering Centre Old Dominion University	DRAWING NUMBER PL-4	



### SECTION C-C



#### Planting Details

1. Within tidal zone, between MHV(+1.32') and low water at -1.3'
2. Stagger rows on 1.5' centers
3. Plant to be spaced 1.5' in a row, Spartina Alterniflora
4. Use nursery grown or collected sprigs
5. Plant sprig to approximate depth characteristic of collection site
6. Fertilize per specification

#### Planting Notes

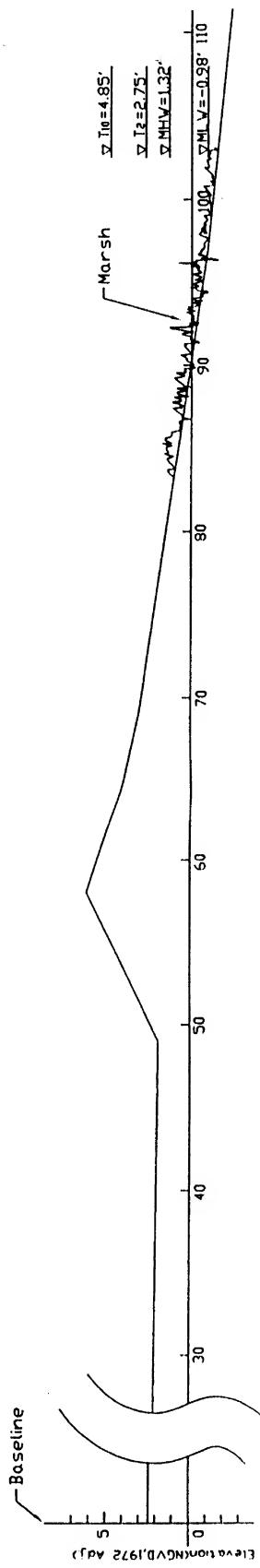
1. Contractor responsible for planting or furnishing marsh grass plants
2. Contractor responsible for preparing all beds to slopes shown using select materials
3. All upland areas disturbed by construction shall be topsoiled and seeded per specifications

Department of the Air Force  
Langley AFB, VA; 1 CES/CEVA

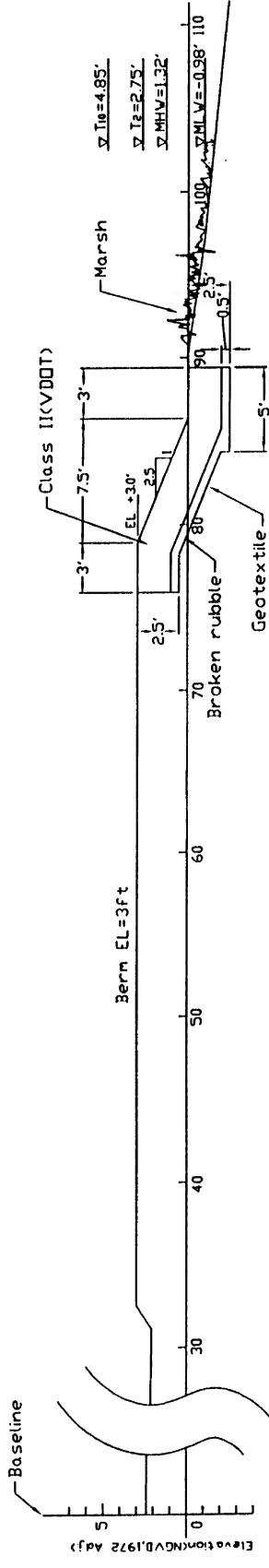
SCALE: 1' = 7'  
DATE: 15 Jun. 2001

DRAWN BY T.O.  
REVISED D.R.B.  
Shoreline Stabilization Design  
Marina Parking Lot (Details, No. 3)

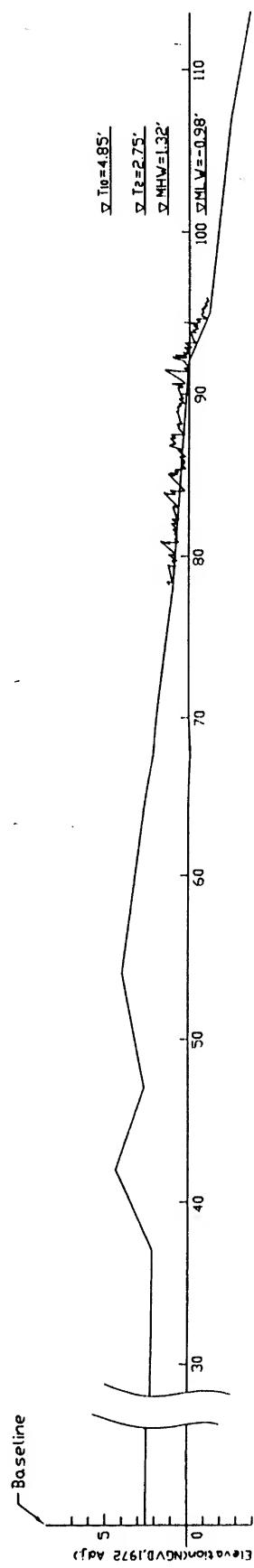
The Coastal Engineering Centre  
Old Dominion University  
DRAWING NUMBER  
PL-5



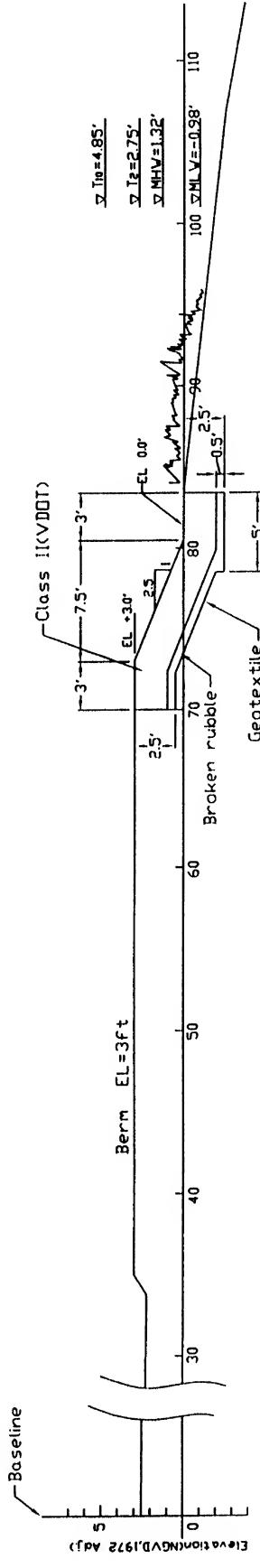
Existing Condition



Department of the Air Force Langley AFB, VA: 1 CES/CEVA	APPROVED BY:	DRAWN BY T.O.
SCALE: 1" = 7'	DATE: 15 Jun. 2001	REVISED D.R.B.
Shoreline Stabilization Design Marina Parking Lot (Details, No.4)		
The Coastal Engineering Centre Old Dominion University		DRAWING NUMBER PL-6



Existing Condition



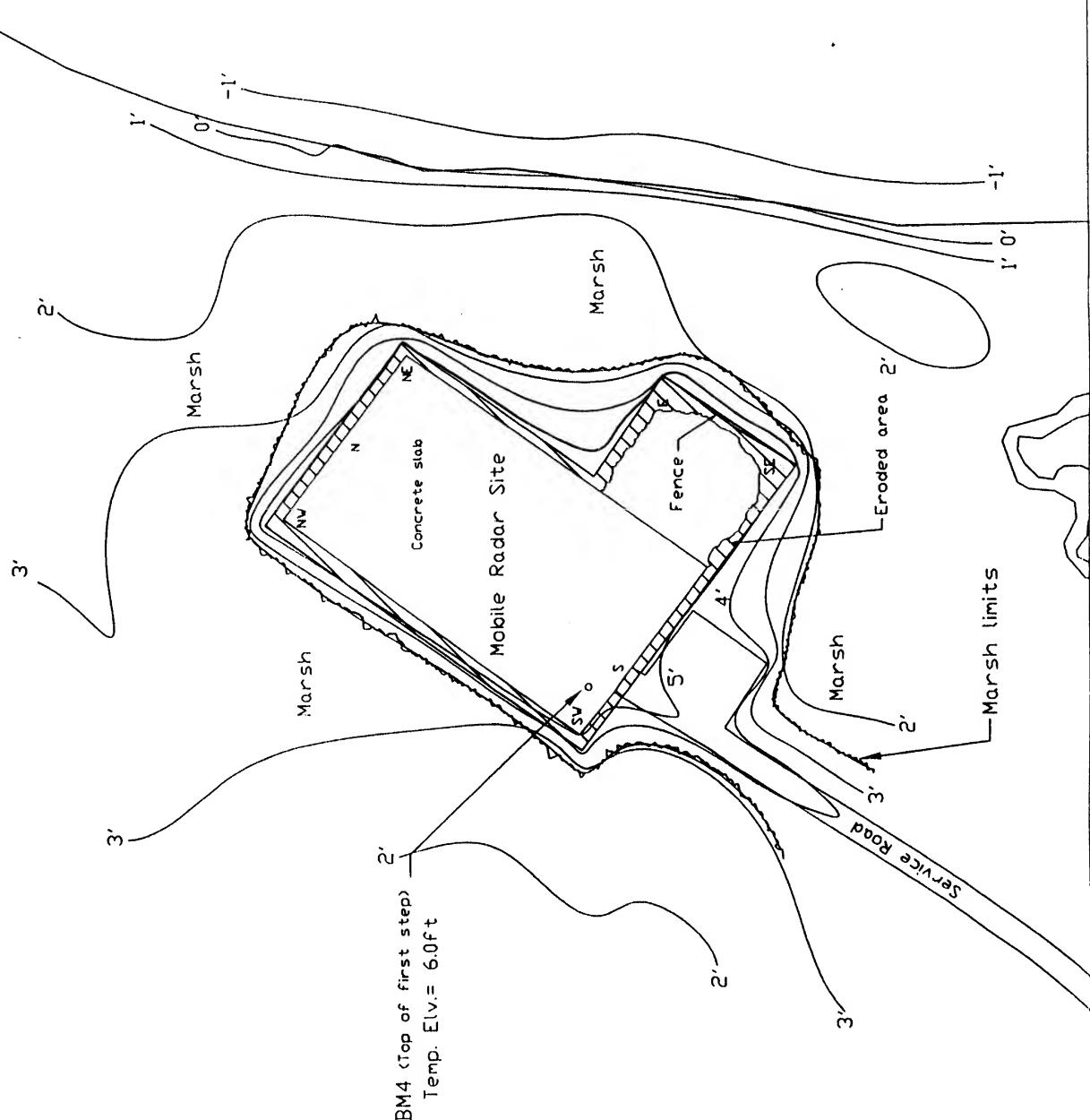
Section E-E

Department of the Air Force Langley AFB, VA; 1 CES/CEVA	
SCALE: 1" = 7'	APPROVED BY:
DATE: 15 Jun. 2001	DRAWN BY T.O. REVISED D.R.B.
Shoreline Stabilization Design Marina Parking Lot (Details, No.5)	
The Coastal Engineering Centre Old Dominion University	DRAWING NUMBER PL-7

Note: Vertical datum is NGVD, 1972 Adj.

## CAUTION

All elevations based on setting +6.0ft(NGVD) for temporary benchmark on stair step within pad area. Final elevations to be checked and confirmed by survey from the nearest benchmark at the site.



0 23 30 (P)

# Attachment E

Department of the Air Force  
Langley AFB, VA; 1 CES/CEVA

1° = 50° APPROVED BY:

Shoreline Stabilization Design

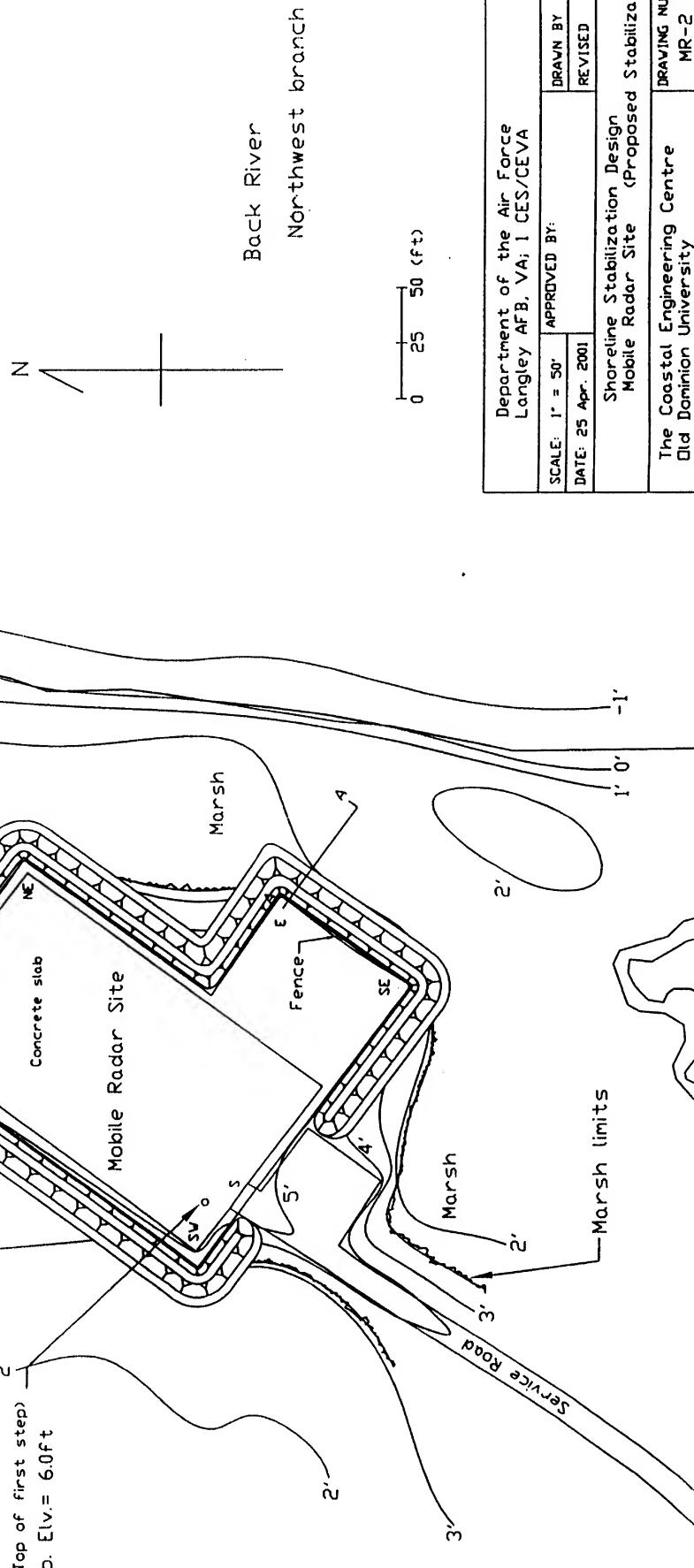
Mobile Radar Site Existing

Coastal Engineering Centre  
Dominion University

Note: Vertical datum is NGVD, 1972 Adj.

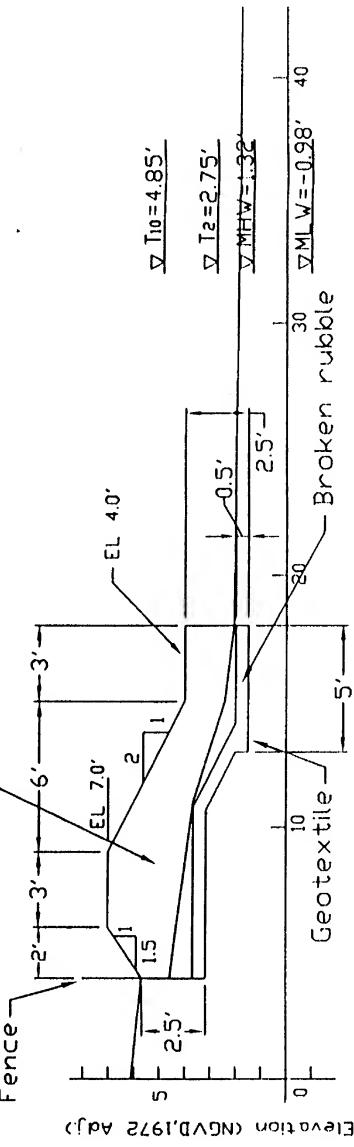
## CAUTION

All elevations based on setting +6.0ft (NGVD) for temporary benchmark on stair step within pad area. Final elevations to be checked and confirmed by survey from the nearest benchmark at the site.



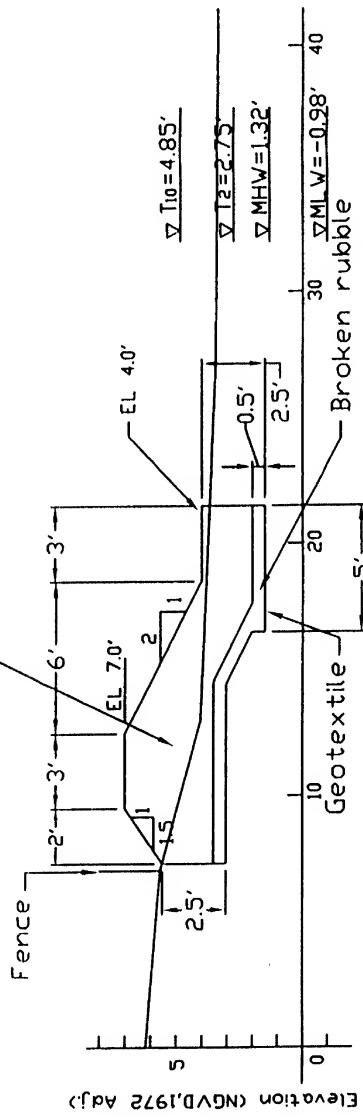
BM4 (Top of first step)  
Temp. Elv.= 6.0ft

### Class II (VDOT)



### Section A-A

### Class II (VDOT)



### Section B-B

### Construction Notes

1. Remove existing broken concrete rubble to allow for fabric installation and revetment construction
2. Regrade existing slope 2H:1V
3. Install geotextile material on slope and undertoe
4. Use pieces of broken rubble to cover bottom layer
5. Any unsuitable hardscape shall be hauled away and disposed of at appropriate off base facility
6. Install 4.0ft. thick layer of VDOT Class II Riprap covering layer completely. Top layer must be VDOT Class II Riprap
7. Avoid equipment damage to existing sidewalk, piers, bulkheads, trees, shrubs, etc. Contractor liable
8. Regrade slope at rear of revetment and reseed
9. Use additional, concrete from Langley recycled clean concrete stockpile

### CAUTION

All elevations based on setting +6.0ft(NGVD) for temporary benchmark on stair step within pad area. Final elevations to be checked and confirmed by field survey from the nearest benchmark at the site.

Department of the Air Force Langley AFB, VA; CES/CEVA		DRAWN BY T.O. REVISED D.R.B.
SCALE: 1' = 5'	APPROVED BY:	
DATE: 25 Apr. 2001		
Shoreline Stabilization Design Mobile Radar Site (Details)		
The Coastal Engineering Centre Old Dominion University	DRAWING NUMBER MR-3	